

Subject-Specific Competencies for Beginning Teachers in Missouri: Elementary Science

Abbreviations used in this document for coding:

- A. **1997 SSC: 2.1** = 1997 Subject Specific Competencies for Beginning Teachers in Missouri Strand 2, Matter and Energy, competency 1, Properties of matter
- B. **CR GenEd** = Missouri Elementary General Education “Natural Science” Certification Requirement
- C. **ACEI: Standard 2b** = Association for Childhood Educational International Standard 2b: Science

2b. Science: Candidates know, understand, and use fundamental concepts in the subject matter of science—including physical, life, and earth and space sciences—as well as concepts in science and technology, science in personal and social perspectives, the history and nature of science, the unifying concepts of science, and the inquiry processes scientists use in discovery of new knowledge to build a base for scientific and technological literacy.

Supporting explanation:

Candidates have a broad general understanding of science and they teach elementary students the nature of science, and the content and fundamentals of physical, life, earth and space sciences, and their interrelationships. They are familiar with, and teach, the major concepts and principles that unify all scientific effort and that are used in each of the science disciplines: (1) systems, order, and organization; (2) evidence, models, and explanation; (3) change, constancy, and measurement; (4) evolution and equilibrium; and (5) form and function. Candidates engage elementary students in the science inquiry process that involves asking questions, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments and explanations. They introduce students to understandings about science and technology and to distinctions between natural objects and objects made by humans by creating experiences in making models of useful things, and by developing students' abilities to identify and communicate a problem, and to design, implement, and evaluate a solution. They know naive theories and misconceptions most children have about scientific and technological phenomena and help children build understanding. Candidates understand the use of assessment through diverse data-collection methods as ways to inform their teaching and to help students learn scientific inquiry, scientific understanding of the natural world, and the nature and utility of science.

- D. **NSTA [2001]: Standard 2.a** = 2001 National Science Teachers Association standards (i.e., those found on the NCATE website: www.ncate.org)
- E. **NSTA [1998]** = 1998 National Science Teachers Association standards conveying more detail than do the 2001 standards; suggested by NCATE as a useful cross-reference to the more recent standards
- F. **National Science Education Standards (NSES):**
 - Unifying Concepts and Processes (**UCP**)
 - Content Standard A (**A**): Science as Inquiry
 - Content Standard B (**B**): Physical Science
 - Content Standard C (**C**): Life Science

- Content Standard D (**D**): Earth and Space Science
- Content Standard E (**E**): Science and Technology
- Content Standard F (**F**): Science in Personal and Social Perspectives
- Content Standard G (**G**): History and Nature of Science
- Grades K-4: **E**
- Grades 5-8: **M**
- Grades 9-12: **H**

G. **S 1,4** = *Show Me Science* Content Knowledge Standards, standards 1 and 4

H. **ETS 0011, III.4** = Educational Testing Service (**ETS**) Praxis II test “Elementary Education: Curriculum, Instruction, and Assessment,” (test 0011), Topic III (science).specification (i.e., the fourth item in the “Tests at a Glance” description of the contents of the science sub-test)

Finally, the following materials are provided in this Elementary Education package:

1. a 2-column table representation of science competencies for the beginning elementary teacher
2. a “narrative” (or list) of the same information in a conventional word processing format

The beginning (preservice) elementary teacher will demonstrate knowledge of and/or competency in the following areas of study:

<p>1: Unifying Concepts and Processes The beginning teacher of science is familiar with, and teaches, the major concepts and principles that unify all scientific effort and that are used in each of the science disciplines (1997 SSC: 1.2; CR GenEd; ACEI: Standard 2b; NSTA [2001]: Standard 1; NSTA [1998], Standard 1; NSES: UCP-1-5)</p>	<p>1.1. systems, order, and organization; 1.2 evidence, models, and explanation; 1.3 change, constancy, and measurement; 1.4 evolution and equilibrium; and 1.5 form and function.</p>
<p>2: Science As Inquiry The beginning teacher of science understands and practices the science inquiry process. (1997 SSC: 1.1, 1.4; CR GenEd; ACEI: Standard 2b; NSTA [2001]: Standard 3; NSTA [1998], Standard 3; NSES: E-A1, A2; S 7; ETS 0011: III.3-4)</p>	<p>2.1 identify questions that can be answered through scientific investigations. 2.2 design and conduct a scientific investigation, including general abilities, such as recognition of the principal elements in an experimental design (i.e., the hypothesis, independent and dependent variables, and controls); systematic observation, making accurate measurements, and identifying and controlling variables; clarifying ideas that are influencing and guiding the inquiry; and comparing ideas with current scientific knowledge 2.3 use appropriate tools (e.g., hand tools, measuring instruments, calculators, and computers for the collection, summary, and display of evidence), techniques, and mathematics to gather, analyze, and interpret data, including selecting the scientific apparatus or instrument appropriate to a specified laboratory or field task and identifying proper operation of such equipment; using the metric system of measurement, recognizing equivalents within that system and selecting units appropriate to a given laboratory or field task; converting between scientific notation and conventional numerals and using scientific notation to perform calculations. 2.4 develop descriptions, explanations, predictions, and models using evidence based on observation and the abilities to differentiate explanation from description, to provide causes for effects, and to establish relationships based on evidence and logical argument and connections between the content of science and the contexts within which new knowledge is developing. 2.5 think critically and logically about relationships between evidence and explanations, including the ability to interpret and express the results of observation and experimentation. 2.6 recognize, construct, and analyze alternative explanations, including the abilities to identify accurate verbal, graphic, and tabular expressions of data derived from observation and experimentation; draw conclusions and make inferences from observations or experimental results presented in verbal, graphic, or tabular form; and describe a scientific relationship in symbolic mathematical terms.</p>

	<p>2.7 communicate scientific arguments and explanations.</p> <p>2.8 use mathematics in all aspects of scientific inquiry to ask questions; to gather, organize, and present data; and to structure convincing explanations.</p>
<p>3: Physical Science: The beginning teacher of science understands the central concepts, tools of inquiry, and structures of the physical sciences and makes these aspects of subject matter meaningful for students.</p> <p>(1997 SSC: 2.1, 2.4, 2.5, 2.6, 3.1-3.6; CR GenEd; ACEI: Standard 2b ; NSTA [2001]: Rationale; Standard 1; NSTA [1998], Standard 1; NSES: E-B1, B2, B3; S 1, 2, 7-8; S 1, 2, 7-8; ETS 0011: III.1-2)</p>	<p>3.1 Properties of Objects and Materials (1997 SSC: 2.1, 2.4, 2.5; NSES: E-B1)</p> <p>3.2 Position and Motion of Objects (1997 SSC: 3.1, 3.2, 3.3, 3.5, 3.6; NSES: E-B2)</p> <p>3.3 Light, Heat, Electricity, and Magnetism (1997 SSC: 2.6, 3.4; NSES: E-B3)</p>
<p>4: Life Science: The beginning teacher of science understands the central concepts, tools of inquiry, and structures of the life sciences and makes these aspects of subject matter meaningful for students.</p> <p>(1997 SSC: 4.1-.7, 5.1, 5.2-.6; CR GenEd; ACEI: Standard 2b ; NSTA [2001]: Rationale; Standard 1; NSTA [1998], Standard 1; NSES: E-C1, C2, C3; S 3, 4, 7-8)</p>	<p>4.1 Characteristics of Organisms (1997 SSC: 4.2, 4.4, 4.7, 5.1; NSES: E-C1)</p> <p>4.2 Life Cycles of Organisms (1997 SSC: 4.2, 5.2; NSES: E-C2)</p> <p>4.3 Organisms and Environments (1997 SSC: 4.1, 4.4, 4.5, 4.7, 5.1, 5.2, 5.4-.6; NSES: E-C3)</p> <p>4.4 Regulation and Behavior (1997 SSC: 4.3-.7)</p>
<p>5: Earth and Space Science: The beginning teacher of science understands the central concepts, tools of inquiry, and structures of the earth and space sciences and makes these aspects of subject matter meaningful for students.</p> <p>(1997 SSC: 6.1-.3, 6.5-.7, 7.1-.3; CR GenEd; ACEI: Standard 2b ; NSTA [2001]: Rationale; Standard 1; NSTA [1998], Standard 1; NSES: E-D1, D2, D3; S 5-8; ETS 0011: III.2)</p>	<p>5.1 Properties of Earth Materials (1997 SSC: 6.1-.3, 6.5-.6; NSES: D1)</p> <p>5.2 Objects in the Sky (1997 SSC: 7.1, 7.3; NSES: D2)</p> <p>5.3 Changes in Earth and Sky (1997 SSC: 6.6, 6.7, 7.1-.3; NSES: D3)</p>
<p>6: Science and Technology: The beginning teacher of science understands the relationship between science and technology, can distinguish between natural objects and objects made by humans, and makes these aspects of subject matter meaningful for students by creating experiences in making models of useful things and by developing students' abilities to identify and communicate a problem and to design, implement, and</p>	<p>6.1 distinguish between natural objects and objects made by humans (NSES: E-E3)</p> <p>6.2 use a variety of technologies to model scientific phenomena (NSES: E-E2)</p> <p>6.3 identify and organize materials and other resources, choose suitable tools and techniques, and work with appropriate measurement methods to ensure adequate accuracy in the implementation of a proposed design. (NSES: E-E1 & E2)</p> <p>6.4 analyze and interpret data obtained from an experiment or investigation, including graphical data, and identify and demonstrate an understanding of sources of error in data that is</p>

<p>evaluate a solution. (1997 SSC: 1.3, 1.4; CR GenEd; ACEI: Standard 2b ; NSTA [2001], Standards 4, 5.d; NSTA [1998] Standards 2, 4, 5; NSES: E-E1, E2, E3; S 8; ETS 0011: III.1-2)</p>	<p>presented (NSES: E-E1 & E2) 6.5 demonstrate understanding of scientific measurement and notation systems (NSES: E-E2) 6.6 collaborate as a team-member in the identification, communication, and resolution of scientific and technological problems. (NSES: E-E2)</p>
<p>7: Science in Personal and Social Perspectives: The beginning teacher of science understands the context of science (i.e., relationships among systems of human endeavor including science and technology; relationships among scientific, technological, personal, social and cultural values; and the relevance and importance of science to the personal lives of students) and the social context of science teaching (i.e., the social and community support network within which science teaching and learning occur; relationship of science teaching and learning to the needs and values of the community; and involvement of people and institutions from the community in the teaching of science) and uses this knowledge to enrich the science learning of all students. (1997 SSC: 1.3, 4.3, 4.6, 5.1, 5.4-.6, 6.1; CR GenEd; ACEI: Standard 2b ; NSTA [2001]: Standards 4, 7; NSTA [1998], Standards 4, 7; NSES: E-F1, F2, F3, F4, F5; S 1, 3-5; ETS 0011: III.4)</p>	<p>7.1 Personal Health (1997 SSC: 4.3, 4.6; NSES: E-F1) 7.2 Characteristics and Changes in Populations (1997 SSC: 5.1, 5.4-.6; NSES: E-F2) 7.3 Types of Resources (1997 SSC: 6.1; NSES: E-F3) 7.4 Changes in Environments (1997 SSC: 5.1, 5.6; NSES: E-F4) 7.5 Science and Technology in Local Challenges (1997 SSC: 1.3; NSES: E-F5)</p>
<p>8: History and Nature of Science: The beginning teacher of science understands the history and nature of science as a human endeavor and uses this knowledge to make subject matter meaningful for students. (1997 SSC: 1.2, 1.5-.6; ACEI: Standard 2b ; NSTA [2001]: Standard 2.a & 2.b, 4; Standard 7; NSTA [1998], Standard 2.d, 4.b; NSES: E-G1; S 1-8)</p>	<p>8.1 Science as a Human Endeavor (1997 SSC: 1.2, 1.5, 1.6; NSES: E-G1)</p>